

Case Report

Vertebral arterial injury due to fatal dog bites

Toru Oshima MD PhD^{a,*}, Sohtaro Mimasaka MD PhD^b, Kosei Yonemitsu PhD^a,
Katsumi Kita DDS^c, Shigeyuki Tsunenari MD PhD^a

^a Department of Forensic Medicine, Graduate School of Medical Sciences, Kumamoto University, 1-1-1 Honjo, Kumamoto 860-8556, Japan

^b Department of Forensic Medicine, Hirosaki University School of Medicine, Zaifu-cho 5, Hirosaki 036-8562, Japan

^c Kita Dental Clinic, 2-20-28 Egoe, Kumamoto 860-0834, Japan

Received 22 August 2007; received in revised form 1 February 2008; accepted 10 April 2008

Available online 13 June 2008

Abstract

Dog bite-related injuries and fatalities are major public health problem worldwide. The authors present a case of a Japanese Tosa-dog bite-related fatality in an old woman who died from a vertebral arterial laceration with the C5 vertebral fracture. This was an uncommon type of injury that dog bites injured the vertebral artery only without damage to carotid artery. The identity of the Tosa-dog as an offending dog in this case was unsuccessful by a DNA analysis. Then the detection of the offending dog was made by comparisons of the dental casts of the dog with the victim's wounds.

This case report describes making dental cast of the dog, and statistical data on dog-bite incidents in Japan.

© 2008 Elsevier Ltd and FFLM. All rights reserved.

Keywords: Dog bite; Bite mark; Dog dental cast; Vertebral artery injury; Fatal case

1. Introduction

The Japanese Tosa-dog has been revered and feared as fighting dogs throughout Japan for more than 900 years. The Japanese Tosa is a strong, muscular dog with a loyal and protective temperament. It makes an excellent home guardian and is an agile athlete, especially for its size and weight. The Tosa-dog has a strong jaw and its teeth from a scissor bite.¹

Dog bite-related injuries and fatalities are major public health problem worldwide. For example approximately 1–2 million dog bites occur every year in the United States with dog population of 25 million.² In Japan, there are around 6,000 dog bite injuries, and a few fatalities each year.³ The authors present a case of a Japanese Tosa-dog bite-related fatality in an old woman who died from a vertebral arterial laceration with the C5 vertebral fracture.

Vertebral arterial injury is not commonly seen in traumatic deaths.⁴ But, there have been no reports on vertebral arterial trauma caused by dog bite-related fatalities. The identity of the Tosa-dog as an offending dog in this case was unsuccessful by a DNA analysis to detect the victim's DNA from the dog. Then the detection of the offending dog was made by comparisons of the dental casts of the dog with the victim's wounds. Details of the dog bite analysis are reported in this paper.

2. Case report

2.1 History

In April 2006, 79-year-old woman was found dead lying her face down on the street. Her body was covered with extensive blood. The neighboring house dog, a 4-year-old male Japanese Tosa-dog, was licking around the victim's neck. When an ambulance team arrived at the scene, she was in a state of cardiopulmonary arrest and was bleeding profusely from her right neck. She was confirmed dead at

* Corresponding author. Tel.: +81 96 373 5124; fax: +81 96 373 5123.

E-mail address: tooshima@kumamoto-u.ac.jp (T. Oshima).

an emergency hospital in about 1 h latter. The dog owner usually kept the dog in a cage. At the time of the accident, he failed to lock the door of the cage and let his dog run loose out of the cage.

2.2. Autopsy findings

External examination of the victim showed well developed body of a 79-year-old woman, 154 cm in length and 57.5 kg weight. Autopsy revealed lacerations 2.0–5.0 cm long and 3.0–7.4 cm deep over both sides of neck (Fig. 1). On the back side of the neck, lacerations 1.2–1.5 cm long and 0.7–2.5 cm deep were also observed. Four contusions with 7.0–15.0 cm long abrasions were found around the left chest. Multiple valve-type wounds 0.6–3.0 cm long and 1.5 cm deep were located over the left legs.

Internal examination showed that the right sternocleidomastoid muscle was crushed in its middle part and the right internal jugular vein was lacerated. The C5 vertebral transverse process was fractured about 0.3 cm long. The right vertebral artery was lacerated about 1.5 cm long at the level of C5. There was extreme bleeding around its soft tissues (Fig. 2). In general, atherosclerosis is very mild. Other findings were otherwise unremarkable.

Histological and toxicological examinations did not reveal any extra relevant findings. Death was attributed to exsanguinations due to neck blood vessels' laceration subsequent to dog bite.

2.3. DNA analysis

Police forensic laboratory collected swabs from a blood-like spot of the dog's neck and analyzed for the presence of the victim's DNA. However the STR analysis could not reveal identical DNA types in the sample.



Fig. 1. Lacerated wounds on the right side of the neck (arrows). Similar injuries are also observed on the other side of the neck.

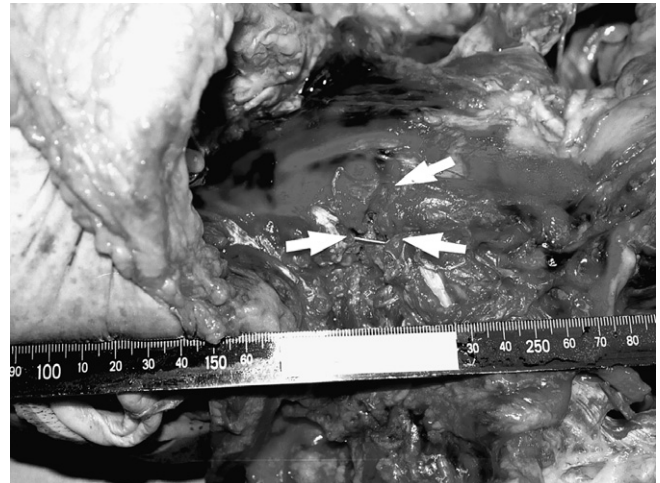


Fig. 2. The right vertebral artery was lacerated at the level of C5 with the vertebral fracture (arrows).

2.4. Dental casts for the bite mark analysis

To detect the offending dog, a dental cast of the Japanese Tosa-dog was made.^{5,6} Anesthesia was induced to the dog with Ketamine hydrochloride (2.3 mg/kg) and Medetomidine (0.03 mg/kg) by an intramuscular injection.

Powders of alginate impression material (Aroma Fine DF III, GC Corporation, Japan) were mixed with distilled water. The mixing ratio was 4.2 g of the powder with 10 ml of distilled water at approximately 22 v/v%. The mixed impression material was poured into our original tray and pressed the tray gently against the denture of the dog, and then keep the tray still for 2 min until stickiness of the mixed impression material vanished away. After removing the tray out of the dog's mouth, the harden impression material was rinsed thoroughly with running water. Plaster casts were prepared using dental calcined gypsum (Yoshino Gypsum Co., Ltd., Japan). The occlusal surfaces of the dog's dentures were well replicated in the dental plaster casts.

The dental casts were super-imposed on the photograph of the victim's wounds. The positions of the 4 canines in the both upper and lower jaws showed to be identical to those of the wounds on her left leg. While the positions of the 6 incisors and 2 canines in the upper and lower jaws showed to be identical to those of the wounds on the victim's right or left side of the neck (Fig. 3). Therefore we concluded that the Japanese Tosa-dog was the offending dog in this case.

3. Discussion

Annual mortality rates from dog attacks are reported to be 7.2 case per 100 million individuals every year in the United States.⁷ The highest mortality rate is registered for children and elderly people because they are generally weak and defenseless. The majority (74.1%) of injuries among children aged four and younger are to the head and neck region, whereas only 20% of people aged 15 or

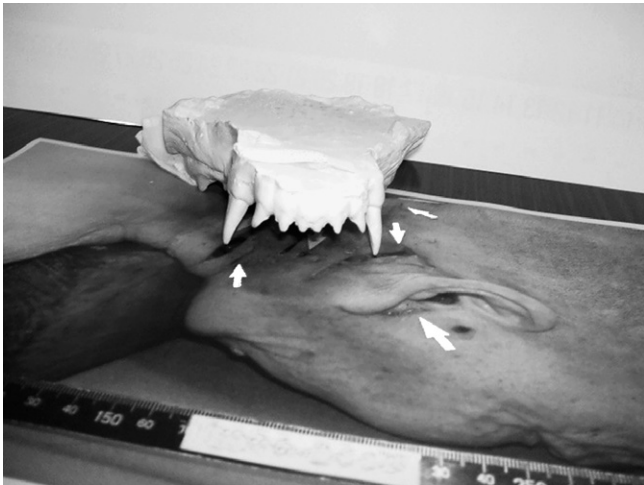


Fig. 3. The dental casts were imposed on the photograph of the victim's wounds. The positions of the 6 incisor and 2 canines in the upper jaw are identical to those of the wounds on the right side of the victim's neck.

older sustain bites to the head or neck.⁸ Our comprehensive retrospective search of Japanese newspaper databases was undertaken to identify articles on dog bite-related fatality during the period from February 1945 to April 2006.⁹ In Japan, the highest mortality rate is also registered for children and elderly people, and the most of all offending dog is Japanese Tosa (29.8%) and Japanese Akita (22.8%). They are large-sized dogs. The majority of injuries among Japanese victims are to the head and neck region (68.4%) in our research. The present case is also a neck injury case of an elderly woman, which can be explained by the large-sized physical characteristics of the Japanese Tosa-dog. The height of the offending dog is 65 cm. The dog can reach the victim's chest with his standing position on his hind legs, and push down her easily.

The vertebral arterial injuries are uncommon in the setting of trauma.¹⁰ According to a clinical report, vertebral arterial injuries account for about only 1% of all neck-vascular injuries.¹¹ Yee et al. reported that nearly 44% of patients with vertebral artery injuries had spine fractures, almost all caused by penetrating trauma.^{12,13} In this case, we conclude that vertebral artery injuries were caused by directly by dog bite, not indirectly produced by fractured transverse process at the level of C5. Because vertebral artery lacerated about 1.5 cm long, it is much longer than fractured transverse process lesion. Dog bite-related carotid artery or extremity artery injuries were sometimes reported.^{14–16} Our case is rare, because the dog bites injured the vertebral artery only without any lacerations of the carotid artery. It is suggested that the Tosa-dog bit her neck from the rear several times as the front side of her neck was completely intact. The ways of the dog's attack were finally concluded that the Tosa-dog bit the victim's left leg first, and jumped up to her chest and pushed her down, and finally bit her neck several times from the back.

For identification of an offending dog, it is reported recently that the DNA analysis is useful.^{17–19} In this pres-

ent case, the presence of the victim's blood on the dog does not particularly imply that the dog had inflicted the injuries. Other examinations to detect the offending dog were needed in this case. Odontological analysis of bite marks may provide conclusive evidences in identifying the offending animal. Dogs have asymmetric upper and lower dental arches. Adult dogs have 42 permanent teeth, 20 in the upper jaws with 6 incisors, 2 canines, 8 premolars, 4 molars, and 22 in the lower jaws with 6 incisors, 2 canines, 8 premolars, 6 molars.⁸ The shape of dog bite wounds will vary considerably, depending upon the size and breed of dog. There may be wide gaps between the impressions made by the different teeth.²⁰ The bite-mark analysis was considered to be useful in this case.

Dog bite-related injuries and fatalities are major public health problem. Criminal charges can be filed against the owner of the dog if that dog has caused a fatal injury. It is very important for forensic personnel to identify animal as the perpetrator of a particular bite wound to the exclusion of all others.

Conflict of Interest Statement

All authors have participated in the design and execution of this report, concurred with the submission, and have no conflict of interest with respect to the publication of this report.

Acknowledgements

The authors wish to express many thanks to Ms. Yuki Ohtsu and Ms. Miki Yoshida in the Department of Forensic Medicine, Graduate School of Medical Sciences, Kumamoto University for their excellent technical supports to the dental identification.

References

1. Steve Ostuni DK, Japanese Tosa. *Kennel Club Dog Breed Series*. Allenhurst: Kennel Club Books, Inc.; 2003.
2. Sacks JJ, Sattin RW, Bonzo SE. Dog bite-related fatalities from 1979 through 1988. *JAMA* 1989;**262**(11):1489–92.
3. Ministry of the Environment, Government of Japan, The 10th congress of the Council for promotion of Animal Welfare, <http://www.env.go.jp/council/14animal/y140-10/mat03_3.pdf>.
4. Opeskin K, Burke MP. Vertebral artery trauma. *Am J Forensic Med Pathol* 1998;**19**(3):206–17.
5. Souviron RR. Animal Bites. In: Dorion RBJ, editor. *Bitemark Evidence*. New York: Marcel Dekker; 2005.
6. Pretty IA, Sweet D. Adherence of forensic odontologists to the ABFO bite mark guidelines for suspect evidence collection. *J Forensic Sci* 2001;**46**(5):1152–8.
7. Sacks JJ, Lockwood R, Hornreich J, Sattin RW. Fatal dog attacks, 1989–1994. *Pediatrics* 1996;**97**(6 Pt 1):891–5.
8. Di Donato S, Ricci P, Panarese F, Turillazzi E. Cane Corso Attack Two Fatal Cases. *Forensic Sci. Med. Pathol* 2006;**2**(2):137–41.
9. The Asahi Shimbun Company, KIKUZOH visual newspaper database, <<http://database.asahi.com/library2/>>.
10. Potsch L, Bohl J. Traumatic lesion of the extracranial vertebral artery—a note-worthy potentially lethal injury. *Int J Legal Med* 1994;**107**(2):99–107.

11. Asensio JA, Valenziano CP, Falcone RE, Grosh JD. Management of penetrating neck injuries. The controversy surrounding zone II injuries. *Surg Clin North Am* 1991;**71**(2):267–96.
12. Yee LF, Olcott EW, Knudson MM, Lim Jr RC. Extraluminal, transluminal, and observational treatment for vertebral artery injuries. *J Trauma* 1995;**39**(3):480–4. discussion 84–6.
13. LeBlang SD, Nunez Jr DB. Noninvasive imaging of cervical vascular injuries. *AJR Am J Roentgenol* 2000;**174**(5):1269–78.
14. Varela JE, Dolich MO, Fernandez LA, Kane A, Henry R, Livingston D, Arnold D, Namias N. Combined carotid artery injury and laryngeal fracture secondary to dog bite: case report. *Am Surg* 2000;**66**(11):1016–9.
15. Endean ED, Kirbo B. Carotid artery occlusion after dog bite. *J Ky Med Assoc* 1995;**93**(10):456–8.
16. Snyder KB, Pentecost MJ. Clinical and angiographic findings in extremity arterial injuries secondary to dog bites. *Ann Emerg Med* 1990;**19**(9):983–6.
17. Padar Z, Egyed B, Kontadakis K, Furedi S, Woller J, Zoldag L, et al. Canine STR analyses in forensic practice. Observation of a possible mutation in a dog hair. *Int J Legal Med* 2002;**116**(5):286–8.
18. Eichmann C, Berger B, Reinhold M, Lutz M, Parson W. Canine-specific STR typing of saliva traces on dog bite wounds. *Int J Legal Med* 2004;**118**(6):337–432.
19. Brauner P, Reshef A, Gorski A. DNA profiling of trace evidence—mitigating evidence in a dog biting case. *J Forensic Sci* 2001;**46**(5): 1232–4.
20. Clark MA, Sandusky GE, Hawley DA, Pless JE, Fardal PM, Tate LR. Fatal and near-fatal animal bite injuries. *J Forensic Sci* 1991;**36**(4): 1256–61.